



National Research
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NRC-CNRC

2009-2010 Estimates

Part III: Report on Plans and Priorities

National Research Council Canada

Tony Clement
Minister of Industry

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Minister's Message

As Minister of Industry, I am committed to the long-term competitiveness and prosperity of our country. Canada has many economic advantages upon which we must continue to build if we are to set the right conditions for our long-term success. With this in mind, Industry Canada and its Portfolio partners are striving toward the development of an innovative economy with robust sectors and an efficient and competitive marketplace.

Our priorities remain aligned with Advantage Canada, the government's long-term economic plan. Here, we set out clear objectives, including the reduction of taxes, the encouragement of entrepreneurship, and the development of a knowledge-based economy.



In the 2009–2010 Report on Plans and Priorities, we recognize that as we look to the year ahead we are entering a period of continued global economic uncertainty, one that demands clear and strategic action on the part of the government to ensure we accomplish the long-term goals we have set for ourselves. Our departmental priorities and initiatives will be guided by a balanced consideration of the demands of the global economic situation and our long-term vision for Canada's growth and prosperity.

In Budget 2009 — Canada's Economic Action Plan, the government has developed a clear and comprehensive response to the slowdown in the global economy, which is in keeping with the continuing objectives of Advantage Canada. The economic action plan addresses short-term realities, while setting in place the conditions to strengthen Canada's economy for generations to come.

Industry Canada and its Portfolio partners are at the heart of the government's strategy to stimulate the Canadian economy. We are taking steps to improve the competitiveness of Canada's traditional economy by providing short-term support for key sectors such as the auto industry. We are ensuring that all regions of Canada prosper by supporting economic diversification. We are fostering small businesses by improving access to credit and encouraging growth through tax reductions and incentives. We are supporting measures to develop a highly skilled workforce through such means as expanding the Canada Graduate Scholarships program. At this time of intense international competition for the world's best and brightest, government support is helping to attract and retain these individuals in Canada. We are positioning Canada as a leader in the global knowledge economy.

In the ongoing pursuit of our mandate, we will continue to focus on innovation as a means to develop a globally competitive economy. Our ultimate goal is to help Canadians continue to enjoy a quality of life that is envied throughout the world.

It is my pleasure to present this year's Report on Plans and Priorities for Industry Canada and its Portfolio partners, which will outline in greater detail the priorities and pursuits in which we will be engaged in the year to come.

Tony Clement
Minister of Industry

Message from NRC President



The National Research Council (NRC), Canada's leading R&D Agency, is a key player in Canada's science and technology infrastructure, helping to bring innovation from the labs to the markets.

In today's global economy, industrial innovation is shaping the competitive position of nations. Canadian companies and communities across the country therefore uniquely benefit from NRC's research excellence, state-of-the-art laboratories and commercialization capacity. NRC's integrated science and technology solutions in key sectors of the Canadian economy help create market advantages that contribute to the competitiveness of Canadian industry and sustain our quality of life.

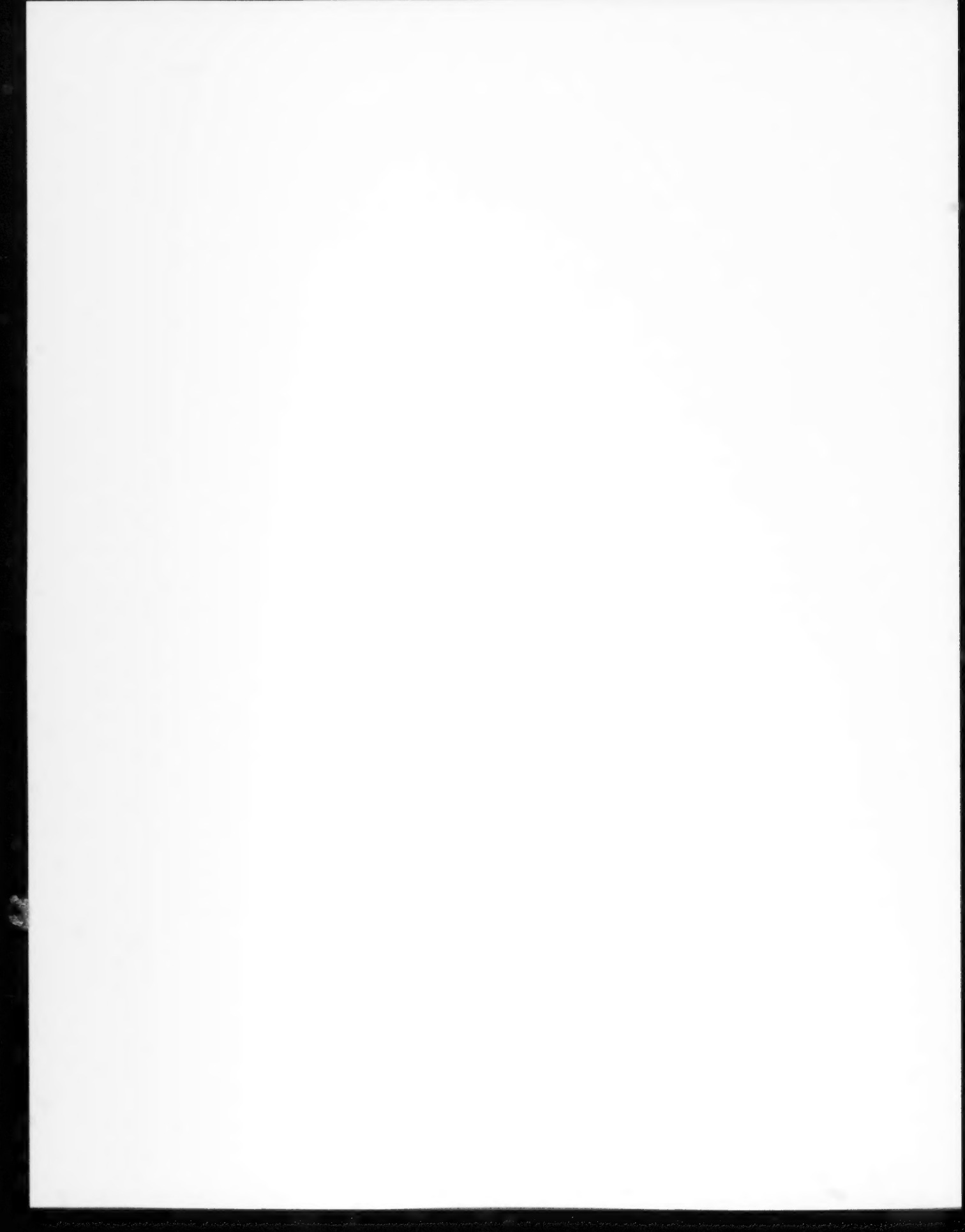
NRC creates value for Canada by transferring technology and knowledge to industry, championing regional technology clusters, securing access to global research networks and facilities, and enhancing international opportunities for Canadian firms and technology products. NRC's role is crucial to improving the economic well-being of the country.

NRC's strategy, *Science at Work for Canada*, is closely aligned with the Government's science and technology strategy, *Mobilizing Science and Technology to Canada's Advantage*. NRC focuses its research and multidisciplinary competencies to address three national priority areas – health and wellness, sustainable energy, and the environment – areas where NRC can make the most significant contribution for Canadians.

NRC's multidisciplinary expertise, its collaborative approach and its international networks are unique assets that help in developing solutions to complex national problems. By linking technologies such as biotechnology, information technology and nanotechnology with disciplines such as manufacturing, transportation, advanced materials and construction, NRC is pushing the boundaries of scientific and technological knowledge and capabilities, allowing for more sustainable economic growth for the benefit of all Canadians.

I am very proud to present the *2009-2010 Report on Plans and Priorities* for the National Research Council Canada, highlighting how NRC will continue to contribute to an innovative, knowledge-based economy for all Canadians, through research and development, technology commercialization and industry support.

Dr. Pierre Coulombe
President
National Research Council Canada



Section I – Overview

1.1 Summary Information

1.1.1 Raison d'être

NRC is the Government of Canada's leading resource for science and technology (S&T) and innovation with a business focus on:

- improving the social and economic well-being of Canadians;
- fostering industrial and community innovation and growth through technology and industry support; and
- supplying excellence and leadership in research and development (R&D).

1.1.2 NRC Mandate

Under the *National Research Council Act*, NRC is responsible for:

- Undertaking, assisting or promoting scientific and industrial research in different fields of importance to Canada.
- Establishing, operating and maintaining a national science library.
- Publishing and selling or otherwise distributing such scientific and technical information as the Council deems necessary.
- Investigating standards and methods of measurement.
- Working on the standardization and certification of scientific and technical apparatus and instruments and materials used or usable by Canadian industry.
- Operating and administering any astronomical observatories established or maintained by the Government of Canada.
- Administering NRC's research and development activities, including grants and contributions used to support a number of international activities.
- Providing vital scientific and technological services to the research and industrial communities.

Consult  <http://laws.justice.gc.ca/en/showtdm/cs/N-15> for more details about NRC's legislative framework.

1.1.3 NRC Accountability Framework

NRC is a departmental corporation of the Government of Canada, reporting to Parliament through the Minister of Industry. NRC works in partnership with the members of the Industry Portfolio to leverage complementary resources and exploit synergies in areas such as innovation of firms through S&T, growth of small and medium-sized firms (SMEs) and economic growth of Canadian communities. The NRC Council provides strategic direction and advice to the President and reviews organizational performance. The President is the leader, responsible for fulfilling corporate strategies and delivering results. Each of five Vice Presidents (Life Sciences, Physical Sciences, Engineering, Technology and Industry Support and Corporate Services) has responsibility for a portfolio of research institutes, programs, and centres.

1.1.4 NRC Operating Environment

The federal S&T Strategy, *Mobilizing Science and Technology to Canada's Advantage*, was launched in May 2007 laying out a plan to build three key advantages for Canada: an Entrepreneurial Advantage, a Knowledge Advantage, and a People Advantage. NRC has unique attributes that support the three Advantages in the federal S&T Strategy and shape its operating environment, including:

Entrepreneurial Advantage

- The ability to help companies move from discoveries in the laboratory to the development, prototyping and commercialization for the global marketplace – since 1995, NRC has spun off/in 68 companies, and in 2007-08 issued 98 licences.
- The ability to put together national programs for delivery in regions across the country.
- A national S&T infrastructure positioned to improve Canada's innovation capacity in existing and emerging fields of research by building networks for researchers and businesses, training highly qualified personnel, creating new technology-based companies and jobs, and transferring knowledge and technology to Canadian companies.
- The capacity to adopt an integrated approach that brings research, technologies and industrial links together in delivering its mandate to provide access to international S&T infrastructures.

Knowledge Advantage

- Leading-edge knowledge generation capability – in 2007-08 alone, NRC published 1,330 articles in refereed journals, presented 821 papers at S&T conferences, and issued 1,541 technical reports.
- The capability to bring together multi-disciplinary research teams to tackle issues of national importance.
- The skills to manage research projects towards specific outcomes as well as long-term goals.

People Advantage

- A core strength of over 4,280 talented and dedicated people. In 2007-08, NRC researchers:
 - held 217 positions on editorial boards of scientific publications
 - were appointed to 473 adjunct professorships in Canadian universities
 - were active in 118 national and international research networks
 - hosted over 1,231 students, postdoctoral fellows and research associates
 - engaged in 407 Canadian and 118 newly signed international collaborative agreements worth \$159M and \$108M respectively.

1.1.5 Strategic Outcome

To effectively pursue its mandate, the Agency aims to achieve the following strategic outcome:

An innovative, knowledge-based economy for Canada through research and development, technology commercialization and industry support.

1.1.6 Program Activity Architecture (PAA)

An innovative, knowledge-based economy for Canada through research and development, technology commercialization and industry support.



1.2 Planning Summary

1.2.1 Financial Resources

Financial Resources	2009-10	2010-11	2011-12
(\$ millions)	705.2	612.0	597.6

The decline in funding from 2009-10 and 2010-11 is largely due to the sunseting of government funding for two major initiatives, including the Technology Clusters Initiatives and program funding for TRIUMF. The decline from 2010-11 to 2011-12 is largely due to the sunseting of the Genomics Research and Development Initiative. In accordance with the normal budgetary cycle, these figures will be revised to reflect future decisions related to the renewal of sunseting programs.

1.2.2 Human Resources

Human Resources	2009-10	2010-11	2011-12
Full-Time Equivalents (FTEs)	4,504	3,996	3,996

1.2.3 Linkage between strategic outcome program activities and government of Canada outcomes

Strategic Outcome An innovative, knowledge-based economy for Canada through research and development, technology commercialization and industry support.						
Performance Indicators Percentage change in private sector client capacity for innovation through growth of client firms. Growth in client capacity for innovation will be measured using the annual R&D expenditures of client firms and the number of technical staff devoted to R&D in client firms.					Targets Establish baseline by FY 2009-10 with a 10% increase in client innovation capacity in subsequent years	
Program Activity	Expected Results	Forecast Spending (\$millions)	Planned Spending			Alignment to Government of Canada Outcomes
		2008-09	2009-10	2010-11	2011-12	
Research and Development	Provide benefits to Canadians through excellence and leadership in research.	444.3	439.9	350.8	339.9	☒ An Innovative and Knowledge-based Economy ☒ Strong Economic Growth
Technology and Industry Support	Enhanced innovation capacity of Canadian firms.	215.8	184.8	186.1	185.9	☒ An Innovative and Knowledge-based Economy ☒ Strong Economic Growth
Internal Services	Enhanced efficiency of R&D activities	83.4	80.6	75.1	71.8	

1.2.4 Contribution of Priorities to the Agency's Strategic Outcome

All NRC priorities contribute to the achievement of its single Strategic Outcome

Operational Priorities	Type	Description
Support Canada's S&T Strategy	New	Why is this a priority? - Over the past decade, funding for federally-performed R&D activities has remained relatively flat. For NRC to continue achieving significant program impacts for Canada, the organization will need to increase its internal and external collaboration. - This priority contributes to building an innovative, knowledge-based economy for Canada by aligning its efforts to the federal S&T Strategy which aims to maximize impact of federal investments in S&T. NRC is well-positioned to play an important role in helping the federal government deliver on its S&T Strategy. Plans for meeting the priority - To contribute to the Entrepreneurial Advantage, NRC will focus on solutions-oriented R&D – building upon its work to support commercialization, and translating research for industrial and social applications. - By promoting and building upon its expertise in areas critical to Canada, such as high impact and emerging industrial sectors – including environmental sciences/technologies, natural resources and energy, and health-related sciences – NRC will contribute to Canada's Knowledge Advantage. - NRC, through its core research program, makes scientific discoveries that benefit the public good and industry in the long term. - In addition to NRC scientists and engineers serving as adjunct professors at Canadian universities, NRC will also continue to employ young graduates – helping them develop and enrich their skills supporting to Canada's People Advantage.
Support and conduct R&D in key industry sectors	Ongoing	Why is this a priority? In the Speech from the Throne on November 19, 2008, the government laid out its key priorities, including securing Canada's energy future, securing jobs for families and communities, expanding investment and trade and making government more effective. NRC has a direct role to play, working with Canadian industries to create innovative solutions. Furthermore, the Speech highlighted that the Canadian manufacturing sector, particularly the automotive and aerospace industries, has been under increasing strain and committed to provide further support for these industries.

Operational Priorities	Type	Description
		- To further address the need to maximize impact of investments in R&D, NRC needs to continuously identify and focus its activities and resources on areas of high priority, while redirecting resources away from lower priority areas. Plans for meeting the priority - In developing its Corporate Strategy, NRC examined the economic importance, R&D intensity, and potential NRC impact of Canada's Industry Sectors and arrived at nine Key Industry Sectors, which include the automotive and aerospace industries. - By targeting these sectors, among others, NRC will contribute to its strategic outcome and strengthen the competitiveness of Canada's economy by focusing its resources on areas where it can have the most impact. - NRC's strategy will be to invest in leading edge research and related infrastructure to support such sectors and the public good, while facilitating increased horizontal and multi-disciplinary R&D to ensure continued future relevance and innovation.
Provide integrated industry support that engages key players	Ongoing	Why is this a priority? - The Canadian innovation system comprises all the organizations that support and conduct research, and transform new knowledge into new products and services for sale into both domestic and international markets. NRC has identified opportunities for addressing gaps and weaknesses in Canada's innovation system that limit the nation's capacity to generate and transform new knowledge into real economic value. Plans for meeting the priority - NRC will enhance Canada's Knowledge Advantage by leveraging its unique S&T and innovation resources to help businesses exploit solutions and opportunities by connecting Canadian R&D organizations to knowledge and expertise produced nationally and around the world. - NRC will provide access to international technology, expertise, resources or distribution networks through licensing deals, strategic alliances, personnel exchanges or management contracts.
Management Priorities	Type	Description
Ensure effective program management for a	Ongoing	Why is this a priority? NRC must be a sustainable and agile national research and innovation organization for Canada in order to achieve its outcome. As it continues to implement its Strategy to 2011, NRC is contributing to sustainability, clear and consistent corporate direction, and relevant

sustainable organization	program support to achieve its goals in alignment with federal S&T priorities. These include more effective management of financial, human and capital resources; supporting mechanisms to facilitate greater internal collaboration to capitalize on providing multi-disciplinary solutions; strengthening NRC relationships and outreach to enhance external collaborations and partnerships and leverage available resources. Plans for meeting the priority • Through its Project DELTA, NRC will put in place a new integrated planning and performance management process, tools and structures to ensure alignment with priorities, and improved reporting of financial and non-financial information for greater efficiency in management and transparency. • NRC will continue the integration of risk management into institute and corporate planning, as well as implementation of a corporate balanced scorecard with relevant indicators to demonstrate performance. • Work will also continue to ensure effective research management and alignment to overall corporate priorities.
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1.2.5 Risk Analysis

Over the next year, developments in NRC's strategic and operating environment will contribute to some notable risks for NRC. The global economic downturn is likely to affect the funding NRC receives directly and through client-based revenues and other partner contributions to research collaborations. Furthermore, the uncertainty of funding renewal for several key programs poses a significant risk to NRC's ability to deliver on its objectives. As a result, NRC must develop contingency plans for managing in their absence and further leveraging limited resources. Recognizing the fiscal situation, NRC may need to re-scope or downscale its planned initiatives for the coming year.

As global competition for highly skilled scientific and technical personnel continues, NRC expects to have an increasingly difficult time competing within its current environment. This is compounded by the large investments that foreign governments are making in R&D and related infrastructure compared to Canada (e.g., National Institute of Standards and Technology in the U.S.) – a noted draw factor for high quality scientific and technical staff. External stakeholders expressed concern that it will become more difficult for Canada to compete in the longer term if it falls behind in these investments now. NRC is exploring options to address the challenges of attracting and retaining high quality people in its current HR plan, which is under development.

Adapting itself to the new operating principles of the federal environment, NRC sets priorities and manages the increasing workload as implementation of NRC's Strategy, in line with the federal S&T direction, progresses. NRC strives to be agile and responsive to clients and stakeholders, while building awareness of NRC's contributions and value to Canada. Lack of awareness is a risk that NRC is mitigating through creation of a new senior executive position and strategy focused on communications and stakeholder relations.

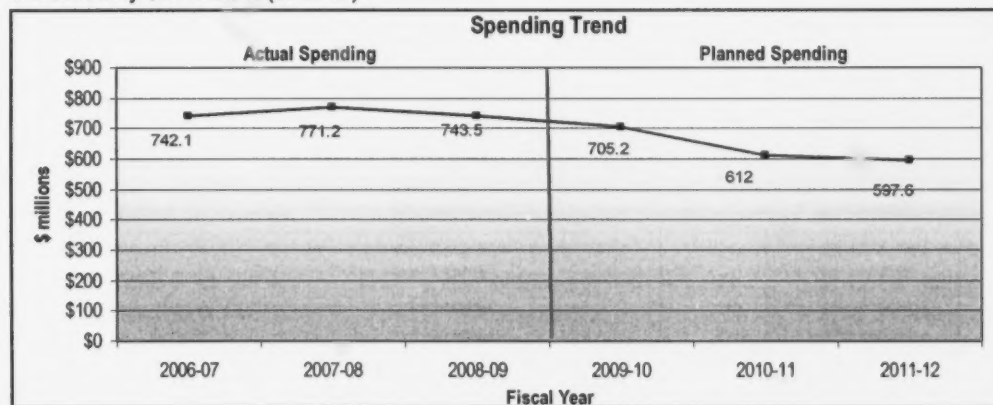
Some of the risks mentioned above can be found within the top 10 strategic risks for businesses in 2008 identified in a recent consultant report (Ernst & Young). These are expected to affect NRC either directly, in terms of a comparable and parallel risk, or indirectly through industry and other partners: regulatory and compliance risk, global financial shocks, aging consumers and workforce, emerging markets, industry consolidation/transition, energy shocks, execution of strategic transactions, cost inflation, radical greening, and consumer demand shifts.

Notwithstanding the risks and challenges expressed above, NRC's science has managed to maintain a leading-edge as evidenced by the number of new national and international agreements signed. In the current operating environment, there are substantial opportunities where NRC, aligned with the priorities of Canada, is uniquely positioned to deliver value. Most notably, NRC:

- is an important and strong engine that will help to deliver on the federal S&T Strategy;
- bridges Canada's fragmented innovation system (regionally based economies, large numbers of SMEs with limited capacity for R&D investment); and
- is ideally positioned to address complex industrial and social problems, capitalizing on converging science and technology trends with its impressive breadth of multi-disciplinary R&D capabilities.

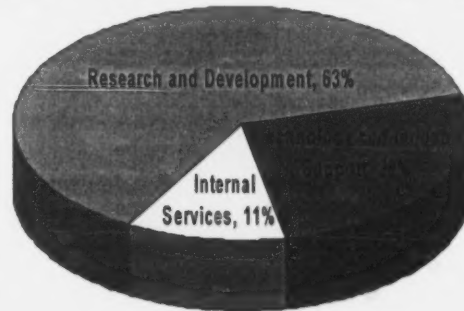
1.2.6 Expenditure Profile

NRC forecast spending for 2008-09 is \$743.5 million. Since fiscal year 2005-2006, spending increased by \$8.6 million (or 1.2%).



The actual and planned spending for fiscal years 2005-2006 to 2008-2009 has averaged about \$747.8 million per year. Total spending has remained relatively stable for this period and has only varied by two to three percent over the average. The planned spending of \$597.6 million in 2011-2012 represents a decrease of \$107.6 million from 2009-2010. This reduction is mostly a result of the sunseting of funding for NRC initiatives and programs such as the Technology Clusters (\$67.8 M), Genomics (\$6.0M), and TRIUMF (\$24.8M). Funding has been provided on a 5-year basis and will sunset at the end of term. The NRC is currently working towards renewing the sunseting funds and the planned spending will be adjusted in a future Report on Plans and Priorities in the event that new funding is approved.

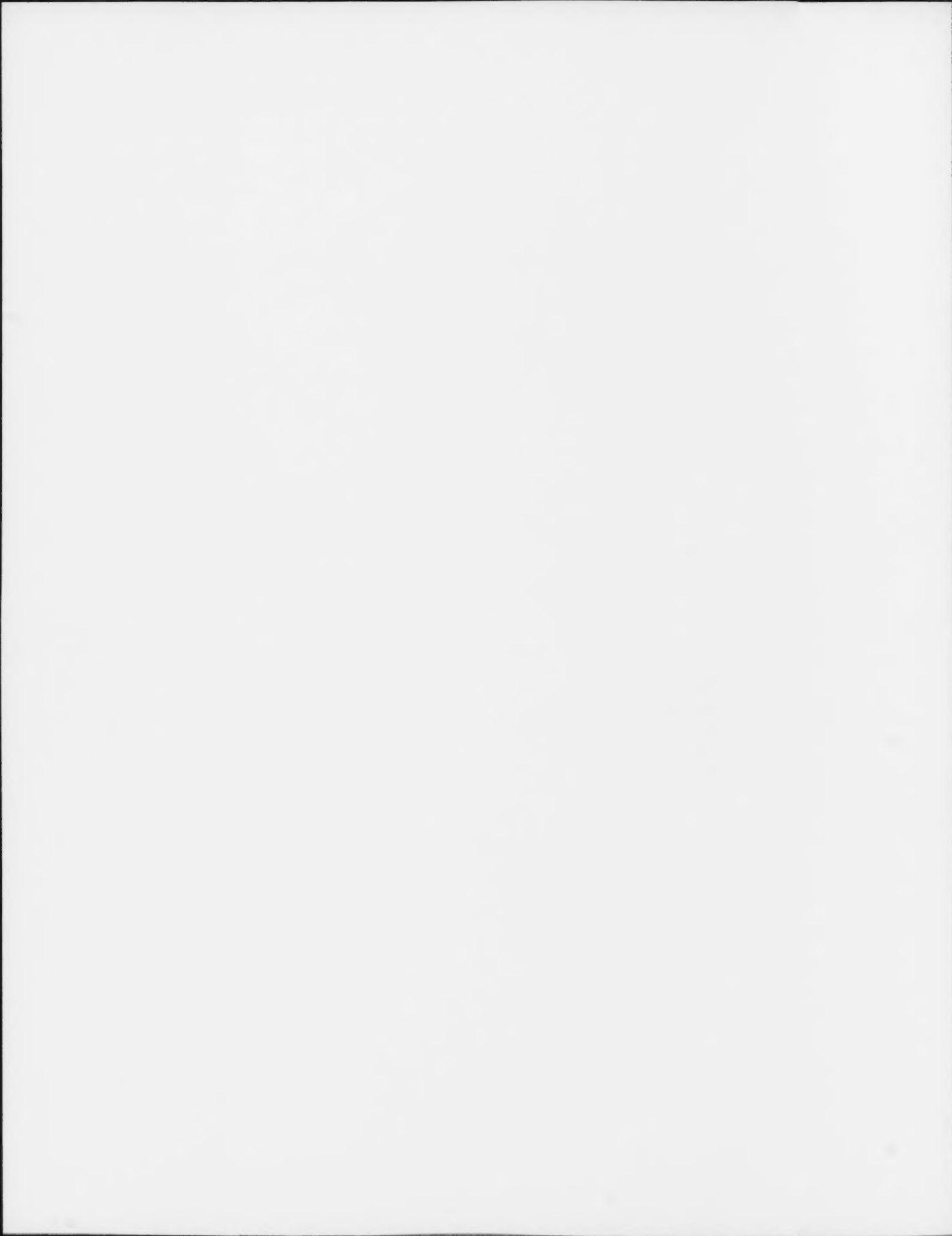
2009-10 Allocation of Financial Resources by Program



Vote #or Statutory Item (S)	Truncated Vote or Statutory Wording	2008-09 Main Estimates (\$ millions)	2009-10 Main Estimates (\$ millions)
50	Operating expenditures	385.5	397.6
55	Capital expenditures	39.7	42.2
60	Grants and contributions	143.6	140.6
(S)	Contributions to employee benefits plans	46.0	45.7
(S)	Spending of revenues pursuant to paragraph 5(1)(e) of the <i>National Research Council Act</i>	83.5	79.0
Total		698.3	705.2

Budgetary (\$ millions)			Loans, Investments and Advances (\$ millions)		
2008-2009	2009-2010	Net Increase/ (Decrease)	2008-2009	2009-2010	Net Increase/ (Decrease)
698.3	705.2	6.9	4.9	5.0	0.1

Note: Due to rounding, figures may not add to total shown.



Section II – Analysis of Program Activities

2.1 Strategic Outcome

An innovative, knowledge-based economy for Canada through research and development, technology commercialization and industry support.

2.1.1 Program Activity – Research and Development

This program activity includes research programs, technology development initiatives and management of national science and engineering facilities and other infrastructure. These efforts focus on: 1) key technological and industrial areas of Canada's economy where NRC has specific roles and recognized competencies; 2) where it can have a significant impact towards national priorities; and/or 3) where developments are critical to sustain Canada's future innovative capacity.

Program Activity Expected Result: Excellence and leadership in research that benefits Canadians.	
Performance Indicator(s)	Target(s)
• Technology licences issued	85 licences in high impact and emerging industry sectors by March 2011
• Publications in refereed journals / proceedings and technical reports	3,500 publications by March 2010

Financial Resources (\$ millions)		
2009-10	2010-11	2011-12
439.8	350.8	339.9

Human Resources (Full-time Equivalents)		
2009-10	2010-11	2011-12
2873	2331	2331

Planning Highlights – Guided by the federal S&T Strategy, NRC focuses strategically in areas that are of national interest from a social and economic perspective. For 2009-10, NRC is taking concerted action towards three main goals:

- To contribute to the global competitiveness of Canadian industry in key sectors and to the economic viability of communities (sector specific and applied research and technology development that contributes now and in the future to a growing and sustainable economy).
- To make significant contributions to Canada's priorities in health and wellness, sustainable energy and the environment – areas critical to Canada's future (longer term innovative research that brings about scientific discoveries for the public good).
- Strengthening Canada's Innovation System and S&T infrastructure (development of critical technology platforms, knowledge dissemination, major S&T infrastructure, codes and standards, etc).

The following are highlights of the activities which will be undertaken towards each of these goals.

Key Industry Sectors

NRC selected nine  Key Industry Sectors for their potential to contribute to Canada's economy. These sectors are technology intensive and depend on innovation for their growth and competitiveness, accordingly, benefiting the most from the resources and knowledge which NRC can provide. To ensure impact and efficiency of its activities, NRC will continue aligning its efforts to defined critical needs and opportunities within these key sectors and supporting research challenges of national importance. The establishment of NRC Key Sector Leads provides the foundation for leveraging NRC resources through ensuring effective market analysis to establish those needs and opportunities, and subsequent planning within these sectors. This approach helps to ensure that key sector activities are managed in a coherent way and that best practices are shared among groups. NRC is also bringing together multi-disciplinary groups of scientists to examine industry needs and opportunities in new ways. Further details of these key sectors are as follows:

 **Aerospace** - The aerospace industry is one of the top manufacturing sectors in Canada. It generates \$22 billion in annual revenues, of which 80% come from exports. It contributes \$9.2 billion to Canada's GDP, accounting for more than 5 % of Canada's manufacturing GDP total, and spends more than \$1.2 billion on R&D. There are roughly 400 aerospace firms in Canada, employing about 79,000 people. Although the Canadian aerospace industry has been steadily recovering, it faces significant challenges. Most notably, the recent global economic instability; restructuring in the global supply chain shifting part of the research and technology development responsibility to SMEs; and greater demand for aerospace environmental technologies. NRC will continue to support and assist Canada's aerospace industry to meet and respond to these challenges by:

NRC plays an important role within the Canadian aerospace sector, linking Original Equipment Manufacturers and SMEs for research and technology development collaborations.

Internationally, it maintains active involvement with research organizations in other countries such as NASA in the US, and plays an important role in NATO Research and Technology Organisation working groups, as well as working groups within The Technical Cooperation Program. NRC also has programs in place to maintain ISO certification and manage controlled goods, including export and sale of defence goods.

- continuing to build competencies and conducting collaborative projects in environmentally sustainable, "green aerospace" technologies focused on lower emissions, alternative fuels, reduced noise, compliant lighter materials, and sustainable processes;
- collaborating with Canadian aerospace SMEs to improve their product and process development capabilities;
- maintaining technical excellence in advanced materials and structures, advanced propulsion systems, aerodynamics, advanced manufacturing, and avionics and flight operations;
- building on a technology road mapping process with industry to jointly identify and prioritize the pre-competitive enabling technologies needed to support strategic technology development;
- continuing to collaborate with other government departments such as Defence Research and Development Canada (DRDC), and universities across Canada on projects with aerospace applications

NRC will continue to take a lead role in several national aerospace networks, including the Air Industries Association of Canada, the Association Québécoise de l'Aérospatiale, the Ontario Aerospace Council, and the Canadian Aeronautics and Space Institute. In addition, NRC will also participate in the Consortium for Research and Innovation in Aerospace in Quebec and in Aéro Montréal, the Montreal Aerospace Cluster.

• **Agriculture** – The federal S&T Strategy refers to agriculture and food science as an important element of Canada's innovation strengths. The impact of climate change; productivity; and health and safety and regulatory issues related to genetically-modified and novel plants are the key challenges of Canada's agriculture sector. In 2009-10, NRC will be engaging, among others, Agriculture and Agri-Food Canada (AAFC), industry, producers, and provincial governments to develop an agriculture key sector strategy that aligns public sector research with private sector needs, helps address sector challenges, and enables market competitiveness of Canadian crops.

NRC and China are combining their research expertise to develop higher-yielding varieties of canola (*Brassica napus*) — a crop that currently contributes more than \$11 billion to the Canadian economy.

NRC uses its leading knowledge capacity in genomics to discover new approaches to improve plant performance and adaptation which would increase crop yield and decrease Canadian production costs. In 2009-10, NRC will:

- form partnerships all along the agriculture value chain from producers to processors, to provide a seamless transition from lab to market, reducing commercialization risks and maximizing success;
- collaborate with India and China to improve Canadian crop production and utilization;
- build on its formal partnership with AAFC to provide a proof-of-concept capability for NRC discoveries;
- work with the University of Saskatchewan and the Province of Saskatchewan to build commercialization transition laboratories and technology transfer offices where researchers and business development professionals from companies and research institutions can work together to guide technologies or products to market entry.

• **Automotive** – The automotive sector is Canada's largest manufacturing sector. Canada has positioned itself as one of the world's most successful countries for the production of vehicles and parts. However, the Canadian automotive sector currently faces daunting challenges and is being confronted with major global competition and technology changes.

Canada is the world's third largest exporter and ninth largest producer of vehicles. Canada's largest manufacturing sector, the automotive sector, is a major contributor to the economy accounting for 12% of manufacturing GDP and generating more than 560,000 jobs. NRC collaborates directly with the automotive sector on work of approximately \$8M value on an annual basis.

NRC has been an effective collaborator of the automotive sector for many years, working on topics such as light weight materials, fuel cells, aerodynamics and manufacturing. NRC contributes significantly to Industry Canada's Automotive R&D partnership initiative, working with NSERC, CFI, SSHRC and CERC. The recommendations of the Industry Task Force advising the Automotive R&D partnership are in close alignment with NRC's priorities (improving the Automobile's

Environmental Performance and Impact, the Cognitive Car and Next Generation Manufacturing). Currently, NRC is developing a new integrated strategy, with particular attention to improved coordination, prioritization and communication. An overwhelming concern pervaded all stakeholder consultations: the long term environmental sustainability of the industry. Environmental concerns are now on equal footing with quality and cost as the top priorities for the automotive industry. Suppliers and R&D centres with expertise in green technology will have the edge. In 2009-10 NRC will finalize the Strategy and undertake activities that focus on the following technology and innovation platforms:

- Fuel Efficiency: light metals, polymer composites and hybrid structures, surface engineering and aerodynamics
- Alternative Propulsion: hybrid and electric vehicles, fuel cell vehicles and alternate fuels
- Connected Car: sensors and sensor networks, telematics and software engineering

BioPharma – NRC is launching a sector strategy that is focusing its multidisciplinary technology and research expertise on developing technology platforms to foster the competitiveness of the BioPharma sector. These platforms will, among other things, help companies identify potential drug targets for specific biological processes such as: tumour genesis and metastasis, proteolytic processes, thrombosis, infectious pathogens, synaptic and neurovascular systems, immunomodulation as well as in glyco-processing.

Most biopharmaceutical companies have licensed in 30-45% of the drugs they have now developed. With \$115 – \$220 billion worth of branded drugs facing patent expiry from 2007 to 2012, and with few new blockbusters in the pipeline, big pharma is under enormous pressure to bring new drugs, primarily biologics, into their pipelines. NRC is well positioned to have a significant impact on Canada's biopharmaceutical sector by investigating potentially novel breakthrough technologies and supporting Canadian SMEs in the Canadian biotech sector.

Through its vast expertise across science and engineering disciplines, industry advice and support, NRC will offer extensive technology support to ensure Canada remains at the leading edge of biopharmaceutical innovation. In 2009-10, NRC will:

- undertake the design and discovery of small molecule and protein based regulators of novel drug targets;
- continue the development of targeted molecular therapies, including the coupling of biomarkers and associated imaging agents with therapeutic candidates for the biopharmaceutical sector;
- assist its partners in bioprocess development and scale up for production and purification of therapeutic candidates;
- strengthen its research facilities to include new technologies, such as high-throughput mAb production and protein microarrays, high-content screening, medicinal chemistry and in-vivo pharmacology;
- move, in collaboration with a Canadian pharmaceutical company, a LPS-based vaccine platform for meningitis B into clinical development. There is currently no vaccine to combat Group B meningococcus which is currently the leading cause of meningitis in the developed world.

Chemicals – The chemical industry has traditionally played a vital role in the Canadian economy as a link between resource industries and downstream manufacturing. It encompasses a diverse cross section of companies that produce organic and inorganic chemicals, plastics and synthetic resins which are critical inputs for almost all other manufacturing industries, with major impacts on Canada's leading manufacturers as well as SMEs. Replacements for traditional petrochemical feed stocks and rising costs and availability of energy are compelling companies to re-invent themselves or explore new opportunities to keep pace with the global economy. Key partners include Industry Canada, the Canadian Chemical Producers Association, Defence Research and Development Canada, Environment Canada and Natural Resources Canada. NRC is in the process of defining its strategy for the Chemical Sector and is working with major industry stakeholders to identify key requirements for technology development and deployment for the next five to ten years. Potential opportunities exist in bio feed stocks and in speciality chemicals, two areas where NRC can have a significant impact. In 2009-10, NRC will develop specific plans based on the stakeholder consultations.

Construction – The construction sector makes a significant impact on the national economy as an economic driver, as well as having a significant environmental impact: constructed facilities consume 35-40% of energy and generate over 25% of solid waste. Equally important, the industry consumes over 50% of primary natural resources and produces 30% of greenhouse gases. Accordingly, this sector will also benefit from NRC's activities that support the federal S&T Strategy in the area of the environment.

Canada's construction sector accounts for 12% of the GDP through the investment of over \$146 billion in capital expenditures. There are over one million employees working in construction, manufacture of building products, engineering and architecture. The industry is fragmented, as the average construction firm is small, with about five employees or fewer; consequently, less than 0.1% of all revenue is reinvested in R&D.

NRC helps target and assess risks associated with the introduction of new materials, technologies and practices in the Canadian construction sector, and also helps, through its nationwide capability, to conduct research that provides opportunities for innovation.

A significant challenge for Canada's construction industry is to transition the sector in the knowledge-based economy. To enable this transition, NRC plans to: develop the knowledge and technologies essential to the creation of a quality and cost-effective built environment; provide integrated decision-making tools that enable the construction sector to respond to changing performance expectations; develop construction process technologies critical to improved productivity in the construction industry. In 2009-10, NRC will continue to undertake the following multi-partner initiatives:

- Indoor Air quality/Clean Air Initiative in cooperation with Health Canada and Environment Canada
- Indoor Environment of Aircraft cabins
- Model energy codes for buildings and housing working with industry associations and federal and provincial regulators
- Barriers to the integration of fuel cells and hydrogen technologies in buildings
- Sensor arrays linked to decision-management tools for more effective operation of indoor environments (potential partnerships being explored with IT-companies and universities)
- Prefabrication, modularization and preassembly

✎ **Medical Devices** – NRC recently launched an initiative to determine how NRC's wide range of competencies can be more effectively integrated and aligned to support the growth of Canada's medical device sector. NRC is currently undertaking an analysis of the Canadian and international landscapes. Once complete, a strategy will be developed, drawing upon the full breadth of NRC's expertise including NRC's activities advancing the federal S&T priority of health, to support the global competitiveness of this sector. Early findings indicate that developing new instrumental techniques and associated software for minimally invasive medical diagnosis and transferring these techniques into clinical use will be one of the significant factors that will drive growth of Canada's medical device sector. This includes biomedical informatics for the classification of disease-related biomedical data, biomedical image processing, and modeling of diseases. NRC will continue its work on sensors and biosensors, magnetic resonance and optical technologies, as well as advancing biomedical informatics. In 2009-10, NRC will work towards developing:

- Materials for molecular diagnostics including novel materials and devices for sampling and sensing molecular components of air, fluids and tissue with applications in infectious and chronic disease diagnostics and public security
- A low field platform that could be used in MR systems for emerging markets – for applications where MR has proven superiority but where cost has been a barrier to widespread acceptance e.g. mammography; and for image guided therapy (both radiation and surgical)
- Leading edge optical technologies that can be used for in vivo medical intervention and surgery, allowing for example, cardiac clinicians to visualize abnormalities inside the blood vessel, at earlier stages of cardiac disease and with greater resolution than current methods
- Applying the advanced materials and fabrication techniques used in microphotonics to an evanescent field sensor aiming for commercialization within 5 years
- New computational techniques for faster diagnosis and treatment of disease

✎ **Information & Communication Technologies (ICT)**

– ICT is one of the four priority S&T sectors identified in the federal S&T Strategy. NRC's strategies in this sector aim to co-create with industry, through research and technology development, the convergent platform technologies that will ensure Canadian industry's global competitiveness in the future. NRC will work towards filling the knowledge and technology development gaps in Canada by building the necessary competencies and

Canada's ICT sector contributed \$65B to Canadian GDP – accounting for 5.9% of Canadian output. 562,000 people are employed by 32,000 companies, 80% of which have fewer than 10 employees. The ICT manufacturing sub-sector remains the largest spender on R&D (\$3.0B), making up 20% of total Canadian private sector R&D expenditures.

working in partnership with industry to address their short and long term issues. In 2009-10, as part of NRC's ICT Strategy, a wireless sensor demonstration project will be conducted, with the participation of six institutes, to address issues affecting the indoor environment of commercial spaces, in support of the construction sector. Three concurrent phases of the project will be carried out: an integrated wireless sensor platform to optimize energy consumption, maintenance cycles and comfort; development of new indoor air quality sensors; and a data mining capability. The project is expected to run three years, culminating in the creation of one or more integrated systems prototypes. This is one example of NRC's key strength in providing integrated solutions to industry that cross multiple areas of expertise. During this timeframe, NRC will also be identifying

other opportunities for technology development in the areas of quantum computing, cyber security and micro and nano systems integration.

As part of the ICT Sector Strategy, an integration group has been formed to move further downstream in the ICT value chain, providing integrated system solutions to

industry. In the domain of photonics, NRC's Canadian Photonics Fabrication Centre, a partnership among the NRC, the Province of Ontario and Carleton University, will continue to provide Canada's photonics clusters a world-class commercial grade fabrication facility dedicated to the fabrication of photonic device prototypes intended to support applications in the fields of information technology, telecommunications and security and the life sciences. The Centre provides design, epitaxy, device prototyping, consulting and process development services and through its partnership with Carleton University is an important training ground for highly qualified personnel – contributing to Canada's *People Advantage*. NRC and its work with the Canadian Photonics Consortium and its member clusters is being heralded as a model by others such as the Photonics Microfabrication Network in Australia and the European Photonics Association, both of which are currently lobbying for similar facilities. This model will be particularly effective for seizing future opportunities that are beginning to flow from the convergence of nanotechnology, biology and photonics. In this regard, the NRC will continue to add services to keep its clients at the leading edge of nanofabrication techniques in order to position Canadian industry at the forefront of the next generation of products requiring nanotechnology enabled devices.

The photonics community in Canada is significant, with about 400 photonics companies and 70 government and academic institutions engaged in product development or in the delivery of research programs.

Manufacturing & Materials – Canada's manufacturing sector faces major challenges such as increased competition and strong innovation investment from foreign market resulting in an increased global offer of low-cost manufactured products to end users. To remain competitive, the Canadian manufacturing sector must address economic, environmental and regulatory challenges. The NRC Manufacturing and Materials Engineering Key Sector Strategy addresses the challenges of four manufacturing segments: primary metal, plastics and composites, metal fabricated products and machinery. NRC works directly or indirectly with companies, industry associations and regulatory organizations at the federal and provincial level. NRC's Automotive Key Sector Lead is in close contact with Industry Canada's Automotive Industry Task Force, ensuring better alignment of federal efforts. NRC plans to address the long term manufacturing sector needs for sustained global competitiveness through fostering:

The Canadian manufacturing sector accounts for 16% of the GDP and provides jobs to over 2 million Canadians. This industry sector is composed of some 60 000 companies, of which 99% are SMEs employing 57% of the manufacturing workforce. Every \$1 dollar of manufacturing output generates \$3 of economic activity.

- Commercialization of value-added innovation by technology intensive firms.
- Enhanced capacity of Canadian companies (particularly SMEs) to compete in the integrated global supply chain.
- Resource efficient manufacturing maximizing the use of renewable sources, and to minimizing energy consumption, waste, rejects and greenhouse gases to address economic, environment and regulatory challenges.

In 2009-10, NRC will continue its development in three critical areas:

1. **Advanced Materials:** functionality and performance development for lighter, safer, affordable and environmentally-conscious products through chemical synthesis, engineering of materials composition and formulation, as well as the development and characterization of nano- and micro- structures.
2. **Innovative Processes:** Materials processing from the laboratory scale to the industrial level aimed at producing lower cost, environmentally-friendly components, devices, assemblies and systems.
3. **Decision-Aid Systems:** Advanced computational and sensing capabilities to improve quality, efficiency, safety and environmental friendliness through simulation models, interaction hardware, processes monitoring diagnostics and performance evaluation.

National S&T Priorities

To support the National S&T Priorities identified in the federal S&T Strategy, NRC clearly aligned its priorities outlined in its Strategy (2006-2011): 1) Health and Wellness to support the federal priority of "Health and Related Life Sciences Technologies"; 2) Sustainable Energy to support "Natural Resources and Energy"; and 3) Environmental Science and Technologies. NRC also undertakes significant activities in the Information and Communications Technologies (ICT), as described the Key Sectors above.

To date, two national programs that address the national S&T priorities of sustainable energy, and environmental have been launched.

The **National Bioproducts Program** was launched in collaboration with Agriculture and AgriFood Canada and Natural Resources Canada, recognizing it was essential to work together to assemble the critical mass required to help address the national Canadian priorities of sustainable energy, the environment, rural revitalization, and sustainable development. The Program aims to address these priorities and to ensure that Canada will be able to successfully compete in the burgeoning global bioproducts sector.

The  **Hydrogen and Fuel Cell National Program**, a partnership among NRC, Natural Resources Canada and NSERC focuses on creating technology applications having short term impacts. It provides research and innovation support in areas critical to the growth of the sector, such as fuels research, system integration and manufacturing and component development. The true economic value of fuel cells lies in an entire system of supporting products and technologies.

Health and Wellness – NRC will continue to focus its efforts on R&D for the diagnosis, treatment and prevention of cancer, cardiovascular, neurological and infectious diseases. Knowledge and technology developed from this research is transferred to health practitioners to ensure a positive impact on the health and wellness of Canadians, as well as, to help build Canada's bio-economy.

 **Plants for Health and Wellness program** focuses on enhancing the yield of natural bioactive compounds from plants that improve human health; delivering novel bioactive/therapeutics compounds via molecular farming (i.e. growing and harvesting genetically modified crops); producing plant-derived pharmaceuticals; and developing new plant-based technology platforms.

NRC will work on applying its technology developments in magnetic resonance, optical techniques, medical photonics, and IT-based decision support systems to improve diagnostic methods and tools. Working with collaborators such as Winnipeg Regional Health Authority, Universities of Calgary, Manitoba, and Dalhousie, and industrial collaborators such as Siemens, Monteris, IMRIS, Sentinelle and Medtronic, the goal is to create rapid point-of-care diagnostic devices with the capacity to improve both the speed and accuracy of patient treatment. In 2009-10, NRC will work towards developing:

- Tools to assist health care providers in using Magnetic Resonance in cancer detection, characterization, and monitoring of cancer.
- Magnetic Resonance and optical techniques to image cardiovascular disease, including ischemia and infarction, as well as non-cardiogenic diseases such as diabetes.
- Novel diagnostic methods for neurology and psychiatry, and treatment planning for neurosurgery, with emphasis on the use of transcranial magnetic stimulation, as well as the integration of magnetoencephalography data. This work will be done in partnership with the Halifax Life Science cluster stakeholders, including Dalhousie University and the IWK – the Biomedical MRI Research Laboratory, and Elekta AB, an international medical device company that would, as a result, have a Canadian presence.
- Tools for understanding the molecular processes underlying critical pathogenic and genetic diseases. In particular, research will focus on diagnosing infectious agents responsible for hospital-acquired infections and threats to food and water safety.

To effectively aid patients it is essential to develop new treatments that will combine targeted therapeutic agents with new and efficient diagnostic methods. This is a critical and exciting area of research with significant implications for all Canadians. In 2009-10, NRC will work towards the following:

Heart Disease: Better Tools for Better Treatment

NRC aims to develop and test new diagnostic and imaging tools that will allow health-care professionals to treat patients earlier and more efficiently by providing a series of methods to triage patients with evolving heart attacks, offer tools for improved planning and guidance of minimally invasive heart surgery, and help predict patient outcomes.

- Identification and further development of selected proteins targeting the tumour microenvironment of breast and brain cancer for therapeutic applications.
- Development of new imaging techniques for better treatment and management of heart disease, particularly for the aggressive treatment of patients at the early stage of a heart attack so as to increase the prognosis for survival.
- Development of novel methods for cardiac repair such as adult stem cells.
- Integration of its unique platforms in neurobiology, glycobiology and immunobiology with those in convergence technologies (IT, nanotechnology, and material sciences) to:
 - develop diagnostics and therapeutics that detect early signs of synaptic failure and enable recovery/re-establishment of synaptic networks (resulting in improvement of motor or cognitive function) in stroke and Alzheimer's disease;
 - develop brain recovery/repair strategies to alleviate consequences of chronic neurodegenerative and cerebrovascular diseases based on integration of vascular and neuronal cells and advanced materials;

- discover pharmaceuticals and vaccines that can be used to combat infectious diseases, neurobiological disorders and cancer; and develop innovative solutions to eliminate the risk of food-borne pathogens from their environmental source.
- Continue with a multi-stakeholder initiative in molecular imaging for better diagnosis of cardiovascular and neurological diseases (supported in part by a Canadian Institutes of Health Research Emerging Team grant), which involves several NRC institutes, collaborators from universities, and a Canadian biotech firm.
- Development and validation of models that can be used to screen bioactives for applications to prevent or treat metabolic disorders, support the immune system and fight against viral infections. These assays will be used for internal projects to identify unique compounds and fractions with commercial potential, and will support the growing bioscience cluster in both Nova Scotia and Prince Edward Island (including such companies as Neurodyn, Chemaphor, ACBV, BioVectra, Ocean Nutrition, Acadian Seaplants Limited).
- Continuing NRC's world-leading biotoxins effort, identifying new toxins and structural analogues, and developing new analytical methods for their detection. During the next five years, NRC will develop analytical tools and reference materials for marine and freshwater biotoxins of importance to human health and to explore possible therapeutic applications of biotoxins.

The NRC will also work on other Health and Wellness enabling technologies such as developing a virtual reality (VR) -based training and rehearsal system, integrated with MRI, for patient-specific surgical oncology. The VR project focuses on neurosurgical oncology, addressing a high-risk surgery that builds on current NRC expertise; and developing text mining tools that can process medical records from several diverse sources and in multiple languages.

Sustainable Energy - As the world's population increases and the demand for energy grows, the challenge shared by all nations is to reduce energy consumption while developing clean, sustainable energy alternatives that are accessible to all. Leading Canada's effort, NRC researchers and their partners are studying three areas: hydrogen and fuel cells; renewable energy and energy storage systems.

The global fuel cell market is projected to reach \$8.5 billion by 2016. Studies show competitive governments are spending an estimated \$1.2 billion annually on fuel cell research and the number one target of current investment: Reducing fuel cell technology costs, making it a commercially viable alternative to conventional energy options. NRC will continue its R&D on key areas to:

- reduce component cost of lower temperature fuel cells by working on: high performance, low-cost catalyst; high performance, low-cost membrane material; and high performance, low-cost gas diffusion layer (GDL) material.
- advance high temperature fuel cell technology by focusing on: developing solid oxide fuel cells (SOFC) technology to support the greening of conventional energy; removing roadblocks for SOFC such as interconnects, bi-layer electrolytes, improved thermally integrated hot box BOP components; and developing novel processes that are conducive to continuous manufacturing, which improves quality control and efficiencies.

- optimize conditions for biological hydrogen production from various organic wastes and crop residues, in continuous fermentation processes using a stable mixed bacterial consortium, and develop an electrochemically assisted microbial fuel cell.

In the area of photovoltaics, NRC is currently in a consortium arrangement with Laval University, St Jean Photochimie and Konarka Technologies to design, fabricate and test organic photovoltaic technology.

NRC will continue applying its scientific discoveries in biofuels, bio-diesel and syngas. Canola, which in Canada currently contributes \$11B in annual economic activity, is a principal source of biofuels and bioproducts. The demand for canola is projected to double from 9 to 17MT by 2015. While the increasing demand presents significant socioeconomic benefits for Canada, meeting it will require significant research and innovation to increase its productive capacity. In 2009-10, NRC will:

- apply genomics-based approaches to improve the productivity, yield, oil content and resilience of Canadian canola crops; develop seed oil profiles for the expanded production of biofuel / biodiesel in canola and other seed crops; and form broader partnerships with energy companies and small plant biotechnology companies to develop these improved sources of plant oil for biofuel use.
- advance chemical and ethanol production from lignocellulosic materials derived from forestry and/or agricultural biomass; develop effective hydrolysis/solubilization of biomass by thermochemical/enzyme pre-treatment to optimize bio-energy production and carboxydrotrophic fermentation processes for gas feedstocks (e.g. syngas) to complement gasification.
- progress production of biofuels from marine algae.

NRC's Clean Energy Technologies Program focuses on the development of safer and lower cost energy storage products for hybrid electric vehicles, stationary systems for the storage of renewable energy and advanced power sources for mobile devices. In collaboration with Natural Resource Canada, NRC is managing a five year initiative, which was launched in 2007, to develop energy storage, electrical drive components, power train optimization and regulations for emissions and fuel efficiency for hybrid electrical vehicles. The program also focuses on the development of next-generation lithium ion battery technology with applications in both stationary electrical storage and transportation.

Environmental Science & Technologies – Science and technology plays a key role in protecting Canada's environment, and environmental S&T is an important source of long-term economic strength for Canada. A healthier and cleaner environment enriches the quality of life in Canada, which attracts and retains the highly skilled and mobile people we need to succeed in the global economy. Responsible development of our natural resources ensures future jobs and wealth creation across the country. NRC is developing sustainable bioprocesses and bioproducts derived from various biomass sources.

NRC will enter new areas of industrial biotechnology, such as green biotransformations, metagenomics and improved processing of biofibers. For example, NRC will:

- work on developing new industrial materials from agriculture biomass residues, namely biofibres from flax and industrial hemp;
- produce biopolymers (PHA and PHB) from renewable resources and substrates using various bacterial systems;
- develop biomaterials and bio-polyols for environmentally friendly automotive, aerospace, and construction products; and
- adapt enzymes into NRC proprietary bioprocess to purify natural fibres for the replacement of fibreglass in industrial materials in the automotive and aerospace industries.

Water will become the limiting resource for the 21st century and the NRC is at the forefront of R&D in assessing and addressing water quality and quantity issues. NRC utilizes biosensors, DNA microarrays, ecotoxicology, and trace-level analytical chemistry to analyze water and develop appropriate treatment systems. In 2009-10, NRC will continue to:

- work on pollution prevention and water-use reduction strategies, focusing primarily on aquifer testing and in-situ bioremediation because groundwater is a major source of Canadian drinking water;
- enhance in situ bioremediation of pollutants in groundwater and aquifers by increasing the performance of biodegradation through different processes;
- improve anaerobic digestion and gasification of biomass and / or municipal waste for energy and chemicals;
- focus on cold-tolerant bacteria and the use of different mechanisms to enhance the processes, including the use of nanoparticles and nutrients.

NRC's environmental monitoring technologies concentrates on air quality, an important issue for Canadians, by detecting and measuring carbon nanoparticles in the atmosphere. The research will assist industry to meet stricter regulations on pollutant emissions and support policymakers and regulators in the development of future air quality standard through the development of new gas sensors and the enhanced measurement of particulates, as well as advanced modeling capabilities. NRC plans to develop 2-D and spectroscopy LII instruments, creating new opportunities for technology transfer and commercialization.

Oil sands are strategically important to Canada. NRC research activities support technologies that reduce water and energy consumption during processing as well as measuring air contaminants from the upstream sectors. Technologies for Sustainable Oil Sands Development focuses primarily on the development of tools to predict bitumen extractability from oil sands to increase yield and enable environmentally friendly recovery of the non-bitumen components. The Program collaborates with Canadian industry through CONRAD (Canadian Oil Sands Network for R&D) and Syncrude as a direct partner.

Regional and Community Innovation

☞ **Regional / Community Innovation** – NRC's technology cluster initiatives are an example of a partnership approach that supports the federal S&T Strategy, through accelerating the commercialization of new technologies, products, processes and services, and by building S&T capacity in key sectors and regions. The initiatives work with universities and colleges to build Knowledge Advantage through coordinated, leading edge R&D programs. Technology cluster initiatives support Entrepreneurial Advantage by enabling industry to translate new knowledge into products, processes and services. These initiatives also work with partners to build People Advantage by attracting new PhD's to the regions, supporting joint-hiring and cross-appointing of researchers to both local universities and NRC, and providing hands-on training for students, and newly skilled expertise for our Canadian SMEs.

Historically, NRC cluster initiatives have been funded on a renewable five-year cycle. With multiple cluster initiatives established at different points in time, the funding cycle has varied. NRC will seek government approval to consolidate the cluster initiatives into a national portfolio and align them into a single funding cycle by 2009-10. In addition, NRC will seek opportunities to more effectively link the activities being carried out in its regional cluster initiatives with Technology and Industry Support activities in Key Industry Sectors. This will help maximize the total impact of NRC, both in local regions/communities, and for the industry as a whole.

National Science and Innovation Initiatives

NRC has a vital and mandated role as Government of Canada to provide critical S&T infrastructure to support excellence in R&D (e.g., facilities, equipment, scientific and technical information). Beyond supporting industry S&T through its current efforts within key sectors, NRC plays a critically important role in ensuring that Canada looks ahead to develop and put in place the technology platforms that will provide it with the necessary innovative capacity for staying leading-edge and continued relevance on the future global R&D stage.

☞ **Nanotechnology** – NRC-Nano, a cross-NRC initiative, coordinates the NRC's nanotechnology efforts, concentrating activities on national priority areas and supporting multidisciplinary, inter-institute research projects. NRC also works under the umbrella of a collaborative agreement among NRC, the Natural Sciences and Engineering Research Council of Canada and the Business Development Bank of Canada to fund projects contributing to nanotechnology development in the priority areas announced in the 2007 federal S&T Strategy: Energy, Environment, and Information and Communications Technologies. This program brings together NRC researchers, university scientists and commercialization expertise with an investment of \$5M per year to fund five projects, in which researchers will develop technologies in collaboration with industrial partners. The projects are now underway with results expected in semiconductor nano-composite materials, photon sources for quantum information processing, polyester nanocomposites and instrumentation for the physical characterization of nano-aerosols. The establishment of NRC's flagship nanoscience institute, the National Institute for Nanotechnology, also represented a new form of partnership

NRC nanotechnology activities are carried out in thirteen of its research institutes across Canada. NRC's total annual expenditure on nanotechnology is just over \$30M and involves more than 300 researchers in a variety of multidisciplinary projects.

among NRC, the Province of Alberta and the University of Alberta to spearhead efforts in this emerging area of technology.

☞ **Canada Metrology** – The increasing globalization of trade over the last two decades has made metrology and the establishment of national measurement standards a key element for export dependent economies such as Canada. NRC plays a vital role in assuring global market access to Canadian industry by reducing non-tariff trade barriers. NRC will continue to work internationally, particularly with the Security and Prosperity Partnership with Mexico and the U.S., toward establishing mutual recognition of standards for testing and measurement in the automotive and chemical sectors, as well as the development of regulatory standards for nanotechnology and other emerging technologies. In addition, NRC is investing in metrology at the nanoscale, an activity essential for the development and commercialization of nano-enabled products by Canadian industry.

☞ **Building Codes and Standards** – NRC plays a national leadership role in developing model building and fire codes and guides of practice; supporting technical standards and facilitating a uniform and nationally integrated code development process. NRC and Natural Resources Canada have joined forces to update the Model National Energy Code for Buildings. With support and leadership from the provinces and territories, updating the model national energy code, last published in 1997, will reflect today's higher energy prices and construction costs, innovations in building materials, systems and designs, and concerns about greenhouse gas emissions. It will also contribute to the development of a single energy standard for buildings, allowing for harmonization among jurisdictions. The new objective-based energy code will be published in 2011.

☞ **Canadian Astronomy and Telescopes** – NRC's Herzberg Institute of Astrophysics executes the mandate assigned in the NRC Act to "operate and administer any astronomical observatories established or maintained by the Government of Canada", a mandate which includes the administration of Canada's interests in several offshore observatories. Through the Institute, NRC is a key participant in Canada's Long Range Plan (LRP) for Astronomy of 2000, which established recommendations and priorities over a decade, with the outlook extended to 2015. Next generation observatories under the LRP include ALMA, an array of 62 sub-millimetre telescopes; the Thirty Metre Telescope, a very large ground-based optical-infrared telescope; and the Square Kilometre Array, a next-generation radio telescope array - all of which fall within the mandate for ground-based observatories. Such major science infrastructure typically requires fifteen to twenty years to pass through all phases from concept to operation, and work on all three of these projects is ongoing with international partners.

Canada has traditionally been a leader in international astronomy and benefits from numerous bi- and multilateral agreements with international agencies. NRC will seek continued funding to maintain these important partnerships to keep Canada at the international forefront with its leading-edge expertise and facilities.

As part of its mandate, NRC provides access to state-of-the-art telescopes for Canadian scientists, as well as to astronomical data that is collected and distributed by the Canadian Astronomy Data Centre. In addition, NRC performs technology development for existing and future observatories, creating leading

The United Nations has declared 2009 the International Year of Astronomy. NRC will participate in the activities planned for this celebration, in partnership with the Canadian astronomy community, to promote science in general and astronomy in particular across Canada. Legacies beyond 2009 are planned, and it is hoped that activities in this landmark year will attract more young people to the sciences.

edge instrumentation for next generation observatories. NRC will continue to coordinate discussions with key stakeholders and will be seeking a policy decision on Canada's national programs in astronomy and astrophysics, as well as additional funding for its share of future LRP projects.

☞ **Canadian Neutron Beam Centre** is a unique facility in Canada, enabling neutron beam experiments to be undertaken on behalf of universities, industry and government researchers across Canada and internationally. The Centre is one of about 20 similar neutron scattering facilities worldwide and is a key part of Canada's science infrastructure. It provides support to over 50 departments from 20 universities and to over 100 foreign institutions each year, one of its main contributions being the training of highly qualified personnel from across Canada. These facilities and expertise are also important resources for government agencies and departments. The Centre supports a wide range of materials characterization including the microstructural analysis of materials for industry. NRC is working to increase the engagement of emerging research communities, with the application of neutron scattering methods to characterize materials that occur in the sectors of energy, the environment and health.

☞ **Tri-University Meson Facility (TRIUMF)** is Canada's national laboratory for nuclear and particle physics, is one of Canada's key investments in large-scale research infrastructure. It provides world-class facilities for research in subatomic physics, life sciences, nuclear medicine and materials science, and fosters the transfer of technology developed at the laboratory to the marketplace as well as other forms of economic and societal benefits. NRC plays an important oversight and stewardship role for TRIUMF, providing funds to the facility on behalf of the Government of Canada via a contribution agreement. A new 2010-15 Plan has been prepared for TRIUMF and reviewed by an NRC International Peer Review Committee. The report of this committee will be presented to NRC Council early in 2009.

2.1.2 Program Activity – Technology and Industry Support

This program activity includes dissemination of scientific, technical and medical information; provision of innovation assistance and engineering and technology-based facilities; contributions to the commercialization process; intellectual property management; new company creation and strategic partnerships for Canadian SMEs, NRC institutes, the public and other government research organizations.

Program Activity Expected Result: Enhanced innovation capacity of Canadian firms	
Performance Indicator	Target
Percentage of technology and industry support clients satisfied with NRC innovation support	80% by March 2011

Financial Resources (\$ millions)		
2009-10	2010-11	2011-12
184.8	186.1	185.9

Human Resources (Full-time Equivalents)		
2009-10	2010-11	2011-12
800	780	780

Planning Highlights – the current turbulent global economic situation will undoubtedly affect Canada's small and medium-size businesses. To what extent these firms are affected remains to be seen. However, it is clear that some firms will struggle while others will not survive.

NRC's  **Industrial Research Assistance Program** has been around for more than 60 years and has adapted and redefined itself over the decades to meet the needs of Canadian SMEs. With a broad suite of services, it is able to switch the emphasis of its offerings to meet the immediate and emerging needs of the SMEs today and help prepare for the future. In stable economic times, SMEs need linkages to sources of assistance, technical and business advisory services and financial support. In the current turbulent times, the need is even greater. In 2009-10, NRC will focus on:

Improving the innovation capacity-building support to SMEs – NRC will ensure that more new firms benefit from the Program's financial and non-financial support – capitalizing on existing and emerging collaborative opportunities with other programs, organizations, and levels of government to increase SME access to needed services and continue to build effective regional/community innovation system relationships and services that benefit all SMEs. This will be facilitated through such structures and actions as Key Sector Teams, investment in NRC's Regional Technology Cluster initiatives, and new partnerships.

Helping industry manage risks as new products are developed and marketed and as new processes and practices are integrated into their operations – In addition to the risk sharing that the Program undertakes with SMEs through its financial support to Canadian firms' technology projects, NRC will continue collaborating with industry in a number of other ways to reduce or manage the risk in developing new products and processes. These include arming the firms with comprehensive market intelligence before they embark on the adoption, adaptation or development of new technologies or process, and helping SMEs become "investment ready"

Providing S&T information and intelligence to industry – NRC provides to their clients advanced market intelligence through the Competitive Technical Intelligence Program. These advanced technical and market intelligence reports are tailored to specific client needs and niches, and have quickly proven to be an invaluable tool for firms in their planning and decision-making process. NRC will continue to enable researchers to remain at the cutting edge of their fields and to find and manage the information, data and supporting analysis needed to effectively develop and execute S&T initiatives. In addition, NRC will ensure that its research results are more visible and available to the world, supporting the translation of research into accessible knowledge that industry and other research partners can use.

Providing comprehensive commercialization support, including technology transfer, intellectual property management, licensing, and entrepreneurship – As part of NRC's continuous efforts to effectively move technology from the lab to the marketplace, NRC recently approved the creation of technology transfer-oriented services which include:

- Intellectual Property (IP) protection support (including patent agent services for protecting IP);
- Licensing administration, including royalty collection;

- Disclosure Review program (through which all of NRC's reports of inventions are reviewed for both marketability factors as well as the usual protectability factors);
- Business advice on negotiating NRC's most complex business deals (including collaborations, consulting contracts, and licences), including the creation of new ventures;
- Development of tools and services to help NRC mount cross-Council initiatives to serve external clients.

One of the main barriers to the continued success of Canadian SMEs is access to funding. There has been a steady decline in the availability of risk financing and it is likely that this trend will continue and even increase in the future. Working with Angel Investor Groups (National Angel Organization and a number of regional angel organizations) and venture capital groups, NRC will finalize and implement a capital readiness assessment tool for firms. The new tool will allow an assessment on the state of investment readiness of a firm and determine what is needed to increase its chances of successfully securing risk financing. NRC's efforts on this front include working with the investment community to ensure that those firms that are deemed "investor ready" have the opportunity to present their cases.

Supporting major science and technology in collaboration with the scientific community and industry – NRC will continue to focus on strengthening technology-based communities through the expansion of the Program's key sector teams. The teams are expanding in number and in depth and breadth of service. NRC is making a significant resource commitment to the initiative by engaging the Industrial Technology Advisor (ITA) leads on a full time basis to work on key sector initiatives. Working in collaboration with NRC's Key Sector initiative leads, the Program's sector teams will contribute in-depth knowledge of the sectors and SME development while ensuring that SMEs, especially in the supply chains, are engaged in and aware of the sector activities and opportunities therein.

2.1.3 Program Activity – Internal Services

Internal Services are groups of related activities and resources that are administered to support the needs of programs and other corporate obligations of an organization. These groups are: Management and Oversight Services; Communications Services; Legal Services; Human Resources Management Services; Financial Management Services; Information Management Services; Information Technology Services; Real Property Services; Materiel Services; Acquisition Services; and Travel and Other Administrative Services. Internal Services include only those activities and resources that apply across an organization and not to those provided specifically to a program.

Financial Resources (\$ millions)		
2009-10	2010-11	2011-12
80.6	75.1	71.8

Human Resources (Full-time Equivalents)		
2009-10	2010-11	2011-12
831	886	886

Planning Highlights

Integrated Structure and Governance Model

NRC has a specific corporate governance model framed by *The National Research Council (NRC) Act* and the authorities it sets out. Over the last four years, NRC has taken steps to strengthen this governance structure and its associated accountability regime to, among other things, more clearly define the role of the NRC Council as a challenge to management decisions and to do so in a manner that is integrated with the annual reporting and planning process at NRC and with the work of the NRC Senior Executive. These measures include the creation of new Council Committees and clarification of their mandates. In 2009-10, a newly established Finance Committee will assist in this process. At the operational level, NRC Senior Executives will be working over the planning period with the Human Resources Branch to refine appropriate accountability structures for the management of its new cross-institute initiatives and National Programs to ensure efficient decision-making in an environment that draws upon many stakeholders as well as NRC business units. (See also below under Human Resources)

Integrated Business and Client Services

NRC will conduct a project to implement the practices and software that will allow staff across Canada to share information about clients and coordinate client interactions. A pilot of the Client Relationship Management program is now underway within the NRC Aerospace Key sector program. This pilot is examining various types of clients, developing protocols for managing clients, reviewing different information needs – all with the ultimate aim to allow NRC to offer larger cross-Council technical solutions to external clients. The pilot has recently been expanded to the NRC automotive key sector to examine what modifications are necessary to implement these practices within a very different industry sector. Related work is underway to apply common practices relating to key account management. At NRC, leads are being identified to act as prime coordinators for activities relating to NRC's most important clients and practices are being developed to allow consistent implementation of these principles.

Integrated Communications, Marketing and Branding

NRC began development of a new strategic communications function framework for NRC in 2008-09, to support and enable key commitments in its Business Strategy and Business Plan. The strategic framework comprises a new organization structure for the function, integrated corporate-level communications, marketing and stakeholder relations strategies and plans, and an amended communications policy framework. The amended organization structure for the function will be implemented by the end of 2009-10, along with fully-integrated strategies and plans for internal and external communications, corporate marketing and corporate-level stakeholder relations. NRC will begin work on the changes to its communications policy framework in 2009-10, with completion scheduled for the end of 2010-11. In addition, NRC will undertake public opinion research and related evaluation/assessment activities to measure the impacts of the changes to its communications function, beginning in 2010-11.

Integrated Ethics Framework

NRC has a unique, ongoing program to promote and encourage ethics and integrity within the organization that involves many operational units within the organization, led in key areas by the Secretary General's Office. Over the planning period, NRC will continue work to develop an Integrated Ethics Framework, which seeks to unite public service and business ethics policies and practices with those related to scientific research around the core of NRC corporate values. The NRC Values are articulated and highlighted in the NRC Strategy: Science at Work for Canada, which will be the core reference for all corporate communications and executive presentations to staff and managers in the planning period.

Human, Capital, IT & Financial Resources fully aligned with priorities

NRC will strive to continue to improve performance efficiency and effectiveness, and management performance. In 2008/09, as a member of the Industry portfolio, NRC participated in a Strategic Review coordinated through the Treasury Board Secretariat. Future planning will integrate NRC's response to the exercise. Efforts will focus on: reducing overhead costs; continuing to increase industry, academic and other government department engagements, consultations and collaborations; and improving management practices, such as strengthening the ability to demonstrate achievement of results.

At present, NRC is in the process of implementing a new integrated planning, performance management and reporting process (Project DELTA). This project will put in place by 2010, the core tools, management frameworks and systems for effectively managing NRC into the future. These include a rigorous and integrated business planning process (now in its second cycle) across NRC, a new model for performance measurement including a corporate balanced scorecard and associated performance indicators, a flexible tool for internal and external financial and non-financial reporting, a new PAA, and ongoing communications and training to facilitate the necessary changes. The results of DELTA will allow more effective capturing and accessing of relevant performance information for better planning and decision making, and ultimately helping to ensure that resources are aligned with priorities.

NRC is also continuing to strengthen its risk management practices (at the corporate and IPB levels), engaging its Senior Executive and Senior Management to ensure that the most critical risks to NRC are identified, assessed and effectively managed. Risk management is built into the overall planning process and the corporate risk profile is a key document to support corporate planning, and feeds into discussions at the Senior Executive Committee's annual priorities retreat. Work is also continuing to integrate good research management with corporate processes through such tools as NRC's Research Management Self-Assessment.

In the Human Resources area, NRC will work to design of a workplace that encourages collaboration and horizontality. To that end, NRC will review its accountability structures to ensure that they allow effective management of cross-boundary initiatives. NRC will review its rewards, recognition and promotion criteria to ensure that they incorporate factors that encourage cross functional collaboration. In addition, NRC's awareness and education activities will focus on how leveraging diversity can drive NRC's innovation. NRC's participation for the first time in the Public Service Employee Survey will provide NRC with an opportunity in 2009-10 to improve the workplace based on formal employee feedback.

To design a workforce that is agile, highly engaged and contributes to NRC's sustainable competitive advantage, in 2009-10 NRC will:

- continue its focus on building leadership capacity and will implement a leadership development roadmap;
- develop a comprehensive succession planning framework to address succession challenges within key areas of vulnerability;
- develop and implement a learning strategy to address priority learning needs in implementing NRC's organizational strategy;
- begin the implementation of a revised employee performance management system that supports NRC's Strategy to 2011;
- design and implement recruitment initiatives and tools including a branding strategy for the NRC to assist the organization in attracting new talent; and
- undertake a review of NRC's staffing policies and practices with a view to increasing NRC's ability to facilitate both the entry and mobility of its workforce.

Other areas of internal services support

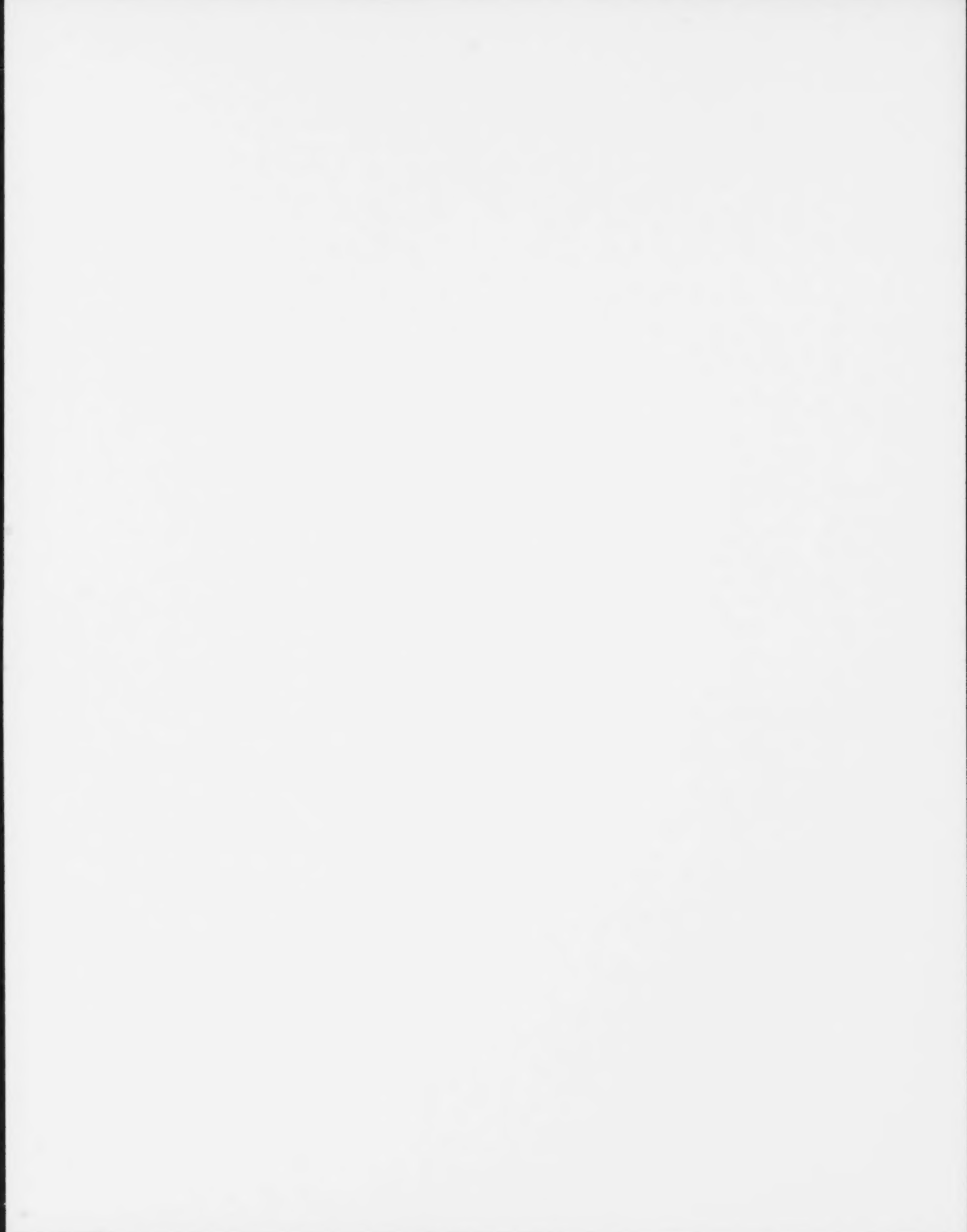
Recapitalization – NRC invested in a major infrastructure review of its buildings that showed that most of the facilities are in relatively good condition. NRC's buildings have a replacement value of over \$1.2 billion and a deferred maintenance backlog of \$170 million. These assets form part of the infrastructure upon which many of Canada's scientific R&D collaborations are developed. NRC's Senior Executive Committee approved a Recapitalization Plan of \$27.0 M over five years to begin to address the backlog.

Occupational Safety and Health – Improving NRC's occupational safety and health services is a key priority for NRC. As work practices become more complex and regulations more strict, the need for better and more thorough documentation and monitoring is growing. NRC, through its Occupational Safety and Health Group will implement an auditing regime and roll out a Hazard Prevention Program across the organization.

Evaluation – Planning and Performance Management's updated evaluation plan, presented to NRC's Senior Executive Committee in November of 2008, outlined a number of areas where measures would be taken to further enhance evaluation capacity and responsiveness in 2009-10 and beyond. Measures outlined include: expanded alignment with the proposed Treasury Board Evaluation Policy; the development of NRC-wide peer review capacity; an update to the NRC Assessment Policy, which was last reviewed in 1996; the development of value for money measures for science and technology, particularly around efficiency and effectiveness, and the testing and expanded use of available data via a proposed NRC-wide performance measurement system.

Internal Audit – The 2008-09 to 2011-12 Risk-Based Internal Audit Plan, presented to NRC's Audit, Evaluation and Risk Management Committee in March 2008 and formally approved by the President upon their recommendation, identified a number of audit priorities to be implemented in accordance with the new Treasury Policy on Internal Audit which must be fully implemented by April 1, 2009. These priorities include: the recruitment of additional personnel to enhance audit capacity; continued development of a strategy for providing annual holistic opinions on risk

management, control and governance processes; and planned audit activities concerning integrated risk management, values and ethics, occupational safety and health, and facilities management in addition to the annual compliance audits for contracts, acquisition cards, hospitality and travel. Much activity will also be undertaken to ensure the members of NRC's Audit Committee are formally appointed by Treasury Board in accordance with the new policy.



Section III – Supplementary Information

3.1 List of Tables

The following tables are located on the Treasury Board Secretariat website:

- ☞ [Details on Transfer Payment Programs \(TPPs\)](#)
- ☞ [Green Procurement](#)
- ☞ [Horizontal Initiatives](#)
- ☞ [Internal Audits](#)
- ☞ [Evaluations](#)
- ☞ [Loans, Investments, and Advances \(Non-budgetary\)](#)
- ☞ [Sources of Respendable and Non-Respendable Revenue](#)
- ☞ [Summary of Capital Spending by Program Activity](#)

3.2 Other Items of Interest

3.2.1 NRC Council Members

NRC's Council reviews the strategic directions and oversees the operations and performance of the organization. It usually meets three times a year and has three standing committees: the Executive Committee, the Human Resources Committee and the Audit, Evaluation and Risk Assessment Committee. The Council is chaired by the President of NRC and the other members are appointed by the Government of Canada for three-year terms. Current members are:

☞ [Pierre Coulombe](#)
President (and Chair of Council)
National Research Council
Ottawa, Ontario

☞ [Paul Clark](#)
Former Vice-President
Research and Technology
NOVA Chemicals Corporation
Calgary, Alberta

☞ [John Harker](#)
President
Cape Breton University
Sydney, Nova Scotia

☞ [Dennis Anderson](#)
Management Consultant
Libau, Manitoba

☞ [Peter Frise](#)
Scientific Director and CEO,
Auto 21
Windsor, Ontario

☞ [Margaret Lefebvre](#)
Executive Director
Canadian Association of Income Funds
Montréal, Quebec

✓ Kellie Leitch

Assistant Dean (External), Chief/Chair of
Paediatric Surgery and Assistant Professor,
Paediatric Orthopaedics
University of Western Ontario
London, Ontario

✓ Eva Mah Borsato

President
Intellectual Capital Corporation Inc.
Edmonton, Alberta

✓ Normand Tremblay

Strategic Management Consultant
Normand Tremblay and Associates
Montréal, Québec

✓ David Wood

Head of Finance and Corporate Development,
Secretary and Treasurer
Celator Pharmaceuticals Inc.
Vancouver, British Columbia

✓ Douglas MacArthur

President
MacArthur Group, Inc.
Charlottetown, Prince Edward Island

✓ Howard Tennant

President Emeritus
University of Lethbridge
Lethbridge, Alberta

✓ Allan Warrack

Professor of Business Emeritus
University of Alberta,
Edmonton, Alberta